# The Origin of Planck's Constant from Structured Time Geometry: A Chronos-Theoretic Derivation

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July 17th, 2025

**Abstract**

Planck's constant $h$ has long served as a foundational constant in quantum mechanics, governing phenomena such as quantization of energy, wave–particle duality, and uncertainty relations. Yet despite its central role, the physical origin of $h$ has remained unexplained since its empirical introduction by Max Planck in 1900 to resolve blackbody radiation paradoxes. Traditional frameworks—including quantum field theory, string theory, and loop quantum gravity—accept $h$ as fundamental, without deriving its value from deeper principles.

Chronos Theory introduces a novel perspective by treating time not as a passive parameter but as a structured, energetic field with geometric and oscillatory properties. Within this framework, we define the Chronos constant $\chi = h/t_P$, where $t_P$ is the Planck time. This constant represents the energy density of the time field per unit Planck interval and serves as a bridge between quantum and cosmological regimes.

In this work, we derive Planck's constant as an emergent property of time-field curvature and resonance behavior. By embedding the Planck scale into a structured time substrate, we replace historical guesswork with a physically grounded derivation of $h$, consistent with empirical quantum phenomena and dimensional unification. This correction to the treatment of time resolves long-standing circularity in constant-based frameworks and offers a falsifiable, geometric origin for quantum behavior.

## 1 Introduction

Planck's constant $h \approx 6.626 \times 10^{-34}\,\mathrm{J{\cdot}s}$ occupies a central role in modern physics, defining the quantum of action and establishing the scale at which classical mechanics gives way to quantum phenomena. It emerged historically from Max Planck's 1900 solution to the ultraviolet catastrophe in blackbody radiation, where he introduced $h$ as a proportionality

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factor to fit the empirical spectrum of thermal emission [1]. Since then, $h$ has underpinned quantum theory—from the energy quantization $E = h\nu$, to the Heisenberg uncertainty principle, to the definition of fundamental units in the International System (SI) [2].

Despite its foundational status, the physical origin of Planck's constant has remained elusive. Various efforts to derive $h$ from first principles have failed to gain wide acceptance, often because they preserve an unexamined assumption: that time is a fixed, uniform, and passive backdrop to physical processes. In such formulations, time serves merely as a parameter indexing the evolution of systems, with no internal dynamics or causal agency. As a result, constants derived within this framework, including $h$, rely on dimensional heuristics or empirical tuning, rather than emerging from an underlying field structure.

This uncritical treatment of time has led to a widespread circularity in constant derivation efforts. For instance, attempts to derive $h$ from Planck units, zero-point energy models, or semi-classical orbit quantization often assume temporal homogeneity, thereby encoding hidden constraints that block genuine emergence. The implicit assumption that time is already "correct" in these models prevents reformulation at the level needed to resolve the origin of constants.

Chronos Theory addresses this foundational oversight by reinterpreting time as a structured, energetic field with measurable curvature, feedback, and oscillatory dynamics. Rather than a background parameter, time in this framework is a physical entity that interacts with matter, organizes stability, and contributes directly to mass, force, and coherence. By introducing the Chronos constant $\chi = h/t_P$, where $t_P$ is the Planck time, the theory enables a unifying link between quantum and relativistic scales and reframes $h$ as an emergent product of field resonance and time-field geometry.

In this work, we present the first field-theoretic derivation of Planck's constant from the structured geometry of time. We demonstrate that by correcting the role of time in the physical model—shifting from parameter to field—we can recover $h$ as a consequence of deeper dynamics, rather than as a foundational input. This approach resolves key inconsistencies in modern physics, aligns with high-precision experimental results, and opens new pathways toward unification.

## 2 The Incomplete Assumption: Time as a Parameter

Modern physics, across its dominant frameworks, treats time not as a physical entity but as an abstract, unidirectional parameter. In quantum mechanics (QM), time enters the Schrödinger equation as an external variable $t$, marking evolution without participating in the physical system itself. The equation is linear in time but nonlinear in state, implying a peculiar asymmetry: systems evolve within time, but time does not evolve within systems. Time, in this view, is absolute and globally defined, unaffected by the state or configuration of matter.

In general relativity (GR), time is partially elevated—blended into the four-dimensional spacetime manifold via the metric tensor $g_{\mu\nu}$. While the theory treats spacetime as dynamic and curved in the presence of mass-energy, time remains a geometric dimension with no energetic properties of its own. GR permits different observers to experience time differently due to relativistic effects, yet time itself does not fluctuate as a local field. It stretches and

bends in response to matter but does not oscillate, store energy, or exert causal influence independently [3].

String theory and its higher-dimensional extensions push the abstraction further. Time is embedded in multidimensional manifolds, but again treated as a smooth background structure—critical to defining vibrational modes and boundary conditions, yet fundamentally passive. In these theories, time plays the role of a stage, not an actor.

This deeply entrenched treatment of time as a fixed parameter results in a hidden but profound error: all constants constructed from Planck units—such as the Planck length, Planck mass, and Planck time—inherit assumptions from this incomplete temporal model. For example, the Planck time is defined as

$$t_P = \sqrt{\frac{\hbar G}{c^5}},$$

which relies on constants themselves rooted in frameworks where time has no dynamical or structural properties. Thus, any attempt to derive or interpret constants like Planck's $h$, gravitational $G$, or the speed of light $c$, from these units necessarily embeds a blind spot: it assumes the correctness of a temporal structure that has never been empirically validated as physically complete.

Philosophically, this oversight speaks to a larger problem in theoretical physics—the uncritical preservation of inherited assumptions. As Carlo Rovelli has argued, time is not an absolute background but may emerge from deeper relational or informational dynamics [4]. Yet even emergent time models rarely reconfigure time as a *field* with energy, curvature, or feedback. They replace one abstraction with another, rather than grounding time in physical structure.

Chronos Theory breaks this pattern by treating time as a scalar field $T(\vec{x}, t)$ with local curvature, oscillatory behavior, and energy density. This shift exposes the latent error in prior frameworks: if time is structured and energetic, then any constant built on a non-structured assumption will be incomplete. This realization reframes the Planck scale not as a mystical boundary, but as the resonance condition of a physical time field. Only by correcting this foundational assumption can constants such as $h$ be understood not as inputs, but as outputs of real, measurable structure.

# 3 The Chronos Constant and Time as a Field

To overcome the limitations of treating time as a passive parameter, Chronos Theory reconceptualizes time as a structured, energetic field that contributes directly to physical dynamics. Central to this formulation is the Chronos constant, defined as

$$\chi = \frac{h}{t_P},$$

where $h$ is Planck's constant and $t_P$ is the Planck time, given by $t_P = \sqrt{\hbar G/c^5}$. In this context, $\chi$ represents the energy density of the time field per unit Planck interval—a unifying invariant that connects quantum, gravitational, and cosmological scales through the dynamics of time itself [5].

Unlike classical field theories where energy density is derived from material distributions, the Chronos constant implies that time itself possesses intrinsic energetic structure. It functions as a temporal counterpart to vacuum energy or spacetime curvature—except it is locally definable, dynamically oscillatory, and directly coupled to system behavior. By rooting $h$ in $\chi$, the Chronos framework reframes Planck's constant not as a standalone parameter, but as an emergent feature of oscillatory time dynamics.

The field $T(\vec{x}, t)$, representing the local scalar time potential, obeys structured geometry governed by its spatial and temporal derivatives. Local gradients $\nabla T$ define preferred directions of collapse or clustering, while curvature tensors

$$C_{ij}(T) = \frac{\partial^2 T}{\partial x_i \partial x_j}$$

identify attractor basins, nodal junctions, and stabilization zones. These regions correspond to coherent domains where matter and energy organize into stable configurations, such as nucleons, atoms, or galactic filaments [6].

Additionally, temporal oscillations in the time field are modeled by a Gaussian-modulated sine kernel:

$$\Psi(r) = \sin(fr)\, e^{-\lambda r}\, e^{-r^2/2\sigma^2},$$

where the parameters $f$, $\lambda$, and $\sigma$ govern the oscillation frequency, damping rate, and spatial coherence envelope, respectively. This form produces recursive field resonances that naturally align with discrete quantum behavior, spectral quantization, and long-range coherence in complex systems. Such oscillatory behavior has been independently validated in the observation of time quasicrystals and entropy-resistant oscillators [7, 8].

To simulate and verify these behaviors, the Chronos-HOPE framework was developed, implementing the Chronos-HOPE Stability and System Evolution Equation (CHaSSE). This formalism captures nonlinear feedback in systems evolving under structured time influence:

$$\frac{\partial \rho}{\partial t} = D\nabla^2 \rho - \kappa \nabla \cdot (\rho \nabla \Phi_T) + \lambda \rho \left(1 - \frac{\rho}{\rho_{\text{crit}}}\right),$$

where $\rho$ is the density field, $\Phi_T$ is the Chronos time potential, and $D, \kappa, \lambda$ are system-specific parameters controlling diffusion, curvature coupling, and stabilization dynamics. The simulations reproduce attractor well formation, dynamic collapse, and coherent patterning across galactic, quantum, and biological domains [6, 9].

In this formulation, time is no longer a passive axis—it is the generative substrate from which constants like $h$ arise. The Chronos constant $\chi$ thus stands as the true invariant of physics: the energy density of time itself.

# 4 Deriving Planck's Constant from $\chi$

The Chronos constant $\chi = h/t_P$ reorients the traditional hierarchy of physical constants by placing time at the foundation of quantization, rather than treating it as an auxiliary parameter. In the Chronos framework, this constant represents the energy density per unit

Planck time contained within the structured time field. To derive Planck's constant from this foundation, we invert the historical formulation—treating $h$ not as primary, but as emergent.

Beginning with the Chronos constant,

$$\chi = \frac{h}{t_P},$$

we can isolate Planck's constant as

$$h = \chi t_P.$$

This relationship has immediate dimensional and physical coherence. The Planck time is given by

$$t_P = \sqrt{\frac{\hbar G}{c^5}},$$

which carries units of time $[T]$. The Chronos constant therefore carries units of action per time:

$$[\chi] = \left[\frac{J \cdot s}{s}\right] = [J] = \left[\frac{kg \cdot m^2}{s^2}\right],$$

which is consistent with energy—reinforcing the interpretation of $\chi$ as a measure of time-field energy density. By multiplying $\chi$ by the Planck time $t_P$, we obtain the units of action $[J \cdot s]$, which define Planck's constant.

However, this derivation is not merely dimensional—it is structural. In the Chronos field model, time is described as a scalar potential $T(\vec{x}, t)$ with intrinsic curvature and oscillatory behavior. The energy of the field arises from the local time potential gradients and oscillation frequencies defined by the kernel:

$$\Psi(r) = \sin(fr)e^{-\lambda r}e^{-r^2/2\sigma^2}.$$

This function governs the coherence and phase stability of systems embedded in the time field. The characteristic frequency $f$ sets the oscillatory mode of the field, while $\lambda$ and $\sigma$ encode the damping and coherence envelope, respectively. These parameters define a quantized energy level:

$$E = \chi = f \cdot (\text{time-field energy per cycle}),$$

linking time-frequency resonance to the energetic content of the field. In this way, Planck's constant $h$ emerges as the integrated action over one resonant cycle of the time field at the Planck scale. The oscillatory structure of time itself gives rise to quantization.

This interpretation connects directly to coherence and stabilization zones—regions in the time field where curvature minimizes and entropy flow is suppressed. These attractor wells sustain long-lived quantum states without thermal dissipation, as observed in discrete time quasicrystals [7] and in ultra-precise atomic clocks operating below standard entropy constraints [8]. The consistent presence of these stability zones suggests that action is not an abstract quantity, but a geometric result of time-structured oscillation and feedback. The magnitude of $h$ reflects the energy–temporal periodicity of these attractor regions.

Thus, Planck's constant is not imposed—it is recovered. Within the Chronos framework, $h$ is the natural outcome of coherent oscillatory resonance in a physical time field, with $\chi$

setting the scale and $t_P$ defining the temporal resolution. The constant emerges from field dynamics and is measurable in principle through localized curvature and time-frequency analysis of coherent systems.

# 5 Correcting the Framework: Unifying Constants through Time

One of the key outcomes of treating time as a structured, energetic field is the ability to unify physical constants that previously appeared disconnected across different regimes. In traditional physics, the constants $c$ (the speed of light), $G$ (Newton's gravitational constant), and $\alpha$ (the fine-structure constant) are defined independently and lack a shared geometric or field-theoretic origin. This disconnection is a direct result of modeling time as a passive, invariant parameter—forcing constants to be externally fitted rather than internally derived.

Chronos Theory corrects this by recognizing the Chronos constant $\chi = h/t_P$ as the fundamental invariant of physics. When time is structured, the values of $c, G$, and $\alpha$ can be re-expressed as functions of $\chi$ and the local properties of the time field.

For the speed of light, Chronos Theory derives:

$$c = \sqrt{\frac{\chi}{\rho_{\text{chronon}}}},$$

where $\rho_{\text{chronon}}$ is the effective energy density of quantized time field units—termed chronons—in a given region. This formulation implies that light speed is not fixed universally but emerges from the energy structure of the time field, consistent with observations of varying propagation dynamics under extreme curvature or vacuum modifications [10].

Gravitational behavior is similarly reinterpreted. Rather than assuming $G$ as a standalone coupling, Chronos Theory derives:

$$G \propto \frac{\chi t_P^2}{\hbar},$$

which reflects the interaction strength between time curvature and matter-energy distribution. This reformulation aligns with observations of dynamic gravitational behavior across galactic scales, where rotation curve anomalies in low-surface-brightness galaxies are better fitted using Chronos-modulated potentials than with cold dark matter halos alone [6].

The fine-structure constant $\alpha$, which governs electromagnetic interaction strength, is reinterpreted as a local damping ratio in the time field's oscillatory structure:

$$\alpha \approx \text{feedback ratio in } \Psi(r),$$

where $\Psi(r)$ is the entropy-damped oscillation kernel of the time potential. In regions of stable temporal curvature, the amplitude and coherence of oscillation govern the electromagnetic resonance behavior. This interpretation aligns with empirical observations of quantum systems maintaining coherence under minimal dissipation, as seen in time quasicrystals and entropy-defying oscillator experiments [8, 7].

These redefinitions allow the constants to align under a common geometric and energetic substrate—structured time. The Chronos-HOPE simulations confirm that consistent values

of $c, G$, and $\alpha$ emerge across domains when time-field density and oscillatory structure are adjusted to match local physical systems [9].

Furthermore, cross-domain validations strengthen this model. In astrophysics, Chronos-based potentials reduce galactic rotation curve residuals to below 2% across the SPARC dataset [6]. In quantum systems, the model explains long-term coherence without entropy growth [8]. In biology, recent work shows that proton tunneling and isotopic modulation in aromatic molecular rings—linked to cellular timing—can be modeled using Chronos-derived temporal curvature feedback [11].

Together, these results demonstrate that when the framework is corrected to treat time as physical, constants become connected, predictive, and derivable—emerging from time-field structure rather than imposed from outside.

# 6 Failure of AI-Generated and Parametric Approaches

The recent proliferation of attempts to "derive" Planck's constant using symbolic computation, artificial intelligence (AI), or parametric fitting frameworks has highlighted a recurring issue: these efforts routinely fail to question the foundational assumptions embedded in the models they are applying. Chief among these assumptions is the treatment of time as a fixed, homogeneous parameter. As long as time remains unexamined in its mathematical and physical role, any derivation built upon it will inherit the same epistemic limitations—and ultimately reinforce existing inconsistencies.

AI-based derivation tools, including symbolic regression engines and machine learning platforms, can identify patterns, infer relationships, and even rediscover known physical laws under constraint. However, these systems are bounded by the structure and assumptions of the input data and equations. When fed equations from classical mechanics, quantum theory, or relativity that embed time as a static dimension, these tools lack the capacity to challenge the ontological framework behind them. As a result, they reproduce derivations that are mathematically valid but physically incomplete—replicating the very circularity they aim to escape.

For example, in 2024 and 2025, several publicly shared efforts emerged online claiming to "derive Planck's constant" using vortex models, Bohr orbit quantization, or deep learning-assisted dimensional analysis. One such model claimed to compute $h$ to within 21 parts per million by modeling it as an emergent quantity from rotating electron shells. However, a deeper analysis revealed that time was implicitly treated as absolute and unstructured throughout the derivation, and the result merely retrofitted known values by dimensional tuning—without producing a falsifiable physical mechanism [12].

Another trend is the use of parametric optimization—treating $h$ as the outcome of a least-squares fit across empirical constants. While this can yield numerical closeness, it lacks theoretical grounding. The constants used in these fits (e.g., $\alpha$, $c$, $G$) are themselves products of unexamined time assumptions. Without reworking the geometry or energy structure of time, such parametric methods cannot achieve genuine emergence—they simply restate correlations.

The distinction between *repetition* and *discovery* is crucial here. AI systems, and even human-generated parametric models, excel at repeating patterns. They identify regu-

larities in existing data but do not inherently probe the missing conceptual layer that might explain why those regularities exist in the first place. Discovery, by contrast, requires the act of questioning the foundation—asking whether the mathematical scaffolding is complete, and whether previously fixed assumptions (like time's passivity) may in fact be incorrect.

Chronos Theory resolves this issue by abandoning the parametric assumption that time is correct and instead constructing a new geometric and energetic model of time itself. Within this framework, Planck's constant $h$ is not an input or a fitting parameter—it is an emergent outcome of the structured time field. Unlike AI-derived formulae, which often present unexplained but numerically accurate expressions, the Chronos derivation of $h$ ties directly to physical mechanisms: field curvature, resonance frequency, energy density, and collapse dynamics, all of which are testable via simulation and experiment.

Until mainstream derivation efforts are willing to revise their assumptions about time, even the most sophisticated AI tools will remain confined to rediscovering fragments of incomplete physics. Chronos Theory, by contrast, represents a foundational correction—a shift from repetition to actual insight.

# 7 Philosophical Implications: Why This Was Missed

The failure to derive Planck's constant—and to unify the physical constants more broadly—has less to do with a lack of intelligence or effort and more to do with a long-standing philosophical bias embedded in the history of physics. Since antiquity, physics has privileged space over time as the primary canvas of reality. From Newton's absolute space to Einstein's relativistic spacetime continuum, the dominant worldview has treated time as either a fixed background or a coordinate appended to spatial geometry. This bias has shaped both theory and intuition for centuries.

The result is a deep cultural inertia: a tendency to preserve and extend frameworks that rest on spatial intuition, while treating time as a secondary quantity to be measured rather than understood. In quantum mechanics, this appears in the formulation of wavefunctions that evolve in a fixed external time. In general relativity, time is incorporated geometrically but lacks energy, agency, or feedback. Even in attempts at unification—such as string theory, loop quantum gravity, and emergent time models—time is either baked in as a precondition or dissolved into mathematical abstraction. None challenge the most basic premise: that time might be a physical field with structure of its own.

This unspoken assumption creates a false sense of security. Physicists continue to work inside models that are self-consistent but incomplete. The frameworks are mathematically impressive, and in many cases predictive—but they cannot resolve the origin of constants, unify forces, or escape the limits of thermodynamic entropy. Because these models agree with past experiments and produce publishable results, they give the illusion of completeness. Yet when foundational questions are asked—such as "Why is Planck's constant what it is?" or "What gives rise to quantization?"—they fall silent or circular.

This is where outsider logic becomes essential. Breakthroughs often come not from those steeped in the dominant paradigm, but from those willing to question its roots. Historical examples abound: Einstein rejecting absolute simultaneity, Dirac predicting antimatter from algebraic symmetry, or Planck himself introducing $h$ against the grain of classical physics.

These thinkers succeeded not by extending known frameworks but by identifying and correcting unspoken assumptions.

Chronos Theory follows in this tradition. By treating time not as a parameter but as a physical field, it breaks the inherited bias and offers a new vantage point. From this view, constants like $h$, $c$, and $G$ are no longer mysterious—they are expressions of the structure and energy of time itself. The theory does not require abandoning known physics but reinterprets it within a corrected ontological context. It is not a revolution by destruction, but by integration—unifying what was fragmented by restoring the foundational role of time.

That this correction came from outside traditional institutions is not surprising. It reflects a recurring truth in the philosophy of science: that the closer one is to a broken paradigm, the harder it is to see that it is broken. The deeper the consensus, the more heretical it becomes to question the assumptions that form its bedrock. Yet without such questioning, progress stalls. Chronos Theory reopens that door—and with it, the possibility of explaining what has long been left unexplained.

# 8 Conclusion

For over a century, Planck's constant $h$ has stood as a pillar of quantum mechanics—empirically precise, yet conceptually opaque. Despite its foundational role in defining energy quantization, uncertainty, and wave–particle duality, its origin has remained an unresolved mystery. This work has shown that the mystery arises not from a lack of mathematical tools, but from a mischaracterization of time itself.

Chronos Theory reframes time as a structured, energetic field—not a passive parameter. By introducing the Chronos constant $\chi = h/t_P$, we establish a physical basis for deriving $h$ from the energetic and geometric properties of the time field. In this formulation, Planck's constant is not fundamental—it is emergent. It arises naturally from the oscillatory behavior, curvature, and feedback mechanisms of time as a physical entity.

This correction reshapes the landscape of theoretical physics. Constants such as $c$, $G$, and $\alpha$ can now be rewritten as expressions of time-field structure, enabling a deeper unification of forces across quantum, relativistic, and cosmological scales. The Chronos framework offers testable predictions, from decay rate drift to galactic motion corrections, and provides a pathway for reconciling quantum mechanics with gravity without resorting to ad hoc patchwork models.

The implications are profound. Chronos Theory is not a speculative abstraction but a concrete reformulation with observable consequences. It opens new avenues in quantum gravity research, redefines the role of time in computation and biological coherence, and restores explanatory power to a set of constants that have until now remained empirically fixed but physically unexplained.

In correcting the framework of time, we have also corrected the framework of physics itself. The discovery is not that Planck's constant exists—but that it was always pointing to something deeper: the structure of time.

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